

## **Supplemental Material**

# **Omega-3 Fatty Acid Supplementation Appears to Attenuate Particulate Air Pollution Induced Cardiac Effects and Lipid Changes in Healthy Middle-Aged Adults**

Haiyan Tong<sup>1</sup>, Ana G. Rappold<sup>1</sup>, David Diaz-Sanchez<sup>1</sup>, Susan E. Steck<sup>2</sup>, Jon Berntsen<sup>3</sup>, Wayne E. Cascio<sup>1</sup>, Robert B. Devlin<sup>1</sup>, and James M. Samet<sup>1</sup>

<sup>1</sup>Environmental Public Health Division, NHEERL, US Environmental Protection Agency, Research Triangle Park, NC 27711; <sup>2</sup>Department of Epidemiology and Biostatistics, University of South Carolina, Columbia, SC 29208; <sup>3</sup>TRC Environmental Corporation, Raleigh, NC 27606.

Corresponding author: Haiyan Tong, MD, PhD.

Environmental Public Health Division  
NHEERL, US Environmental Protection Agency  
Mail Code: 58D  
109 TW. Alexander Dr.  
Research Triangle Park, NC 27709  
Phone: (919) 966-4993  
Fax: (919) 966-6271  
E-mail: [tong.haiyan@epa.gov](mailto:tong.haiyan@epa.gov)

## **Table of contents**

- Supplemental Table 1. Estimated dietary fatty acids intake.
- Supplemental Table 2. CAP exposure data of each subject.
- Supplemental Table 3. Individual variables before and after exposure.
- Supplemental Table 4. Plasma lipids before and after supplementations.

**Supplemental Material, Table 1.** Estimated dietary fatty acids intake.

Fatty acids	Fish oil (n=16)	Olive oil (n=13)	P value
Oleic acid (g/d)	19.59±1.86	20.88±1.85	0.63
Linoleic acid (g/d)	10.71±1.22	11.34±1.23	0.72
Linolenic acid (g/d)	1.11±0.15	1.26±0.13	0.46
Arachidonic acid (g/d)	0.13±0.02	0.10±0.01	0.28
Eicosapentaenoic acid (g/d)	0.083±0.045	0.013±0.004	0.18
Docosapentaenoic acid (g/d)	0.025±0.007	0.011±0.002	0.13
Docosahexaenoic acid (g/d)	0.082±0.030	0.042±0.011	0.26
Total omega-3 fatty acid (g/d)	1.30±0.15	1.33±0.12	0.88

The data are the average of all 6 days of intake from each subject during the supplementation period.

Dietary intake estimates were derived by having a registered dietitian enter the diet records into NDSR (Nutrition Data System for Research) which calculates nutrient values using a food composition database containing over 18,000 food items. Data are means ± SE. Student's t-test was used to compare the difference between the fish oil and olive oil groups.

**Supplemental Material, Table 2.** CAP exposure data of each subject<sup>a,b</sup>

Subject	Supplementation	Date	Fine Particle Mass Concentration ( $\mu\text{g}/\text{m}^3$ )	TEOM® Mass Concentration ( $\mu\text{g}/\text{m}^3$ )	Particle Concentration (#/cc)
1	FO	6/30/2009	83.05	88.42	43,359
2	FO	7/7/2009	230.02	234.91	65,528
3	OO	7/14/2009	299.51	272.31	460,621
4	OO	7/21/2009	298.76	300.36	61,291
5	FO	7/28/2009	317.68	312.23	145,762
6	OO	8/4/2009	205.76	206.58	42,240
7	OO	8/11/2009	192.78	194.80	60,702
8	FO	8/18/2009	n/a	284.90	44,372
9	OO	8/25/2009	429.27	451.22	93,879
10	FO	12/15/2009	220.08	201.63	66,992
11	FO	9/15/2009	354.37	331.09	71,199
12	OO	9/29/2009	198.46	186.43	1,181,572
13	FO	10/20/2009	318.83	276.81	692,176
14	OO	10/27/2009	153.52	126.07	79,889
15	FO	11/3/2009	344.72	324.33	404,506
16	OO	11/24/2009	79.25	75.70	151,000
17	OO	1/5/2010	206.18	192.99	655,807
18	FO	2/9/2010	444.64	358.41	550,049
19	FO	5/11/2010	249.47	239.67	164,523
20	OO	3/23/2010	147.09	127.44	630,426
21	FO	4/13/2010	430.03	361.11	1,970,751
22	OO	4/20/2010	335.76	275.43	572,941
23	FO	4/27/2010	257.12	221.94	206,689
24	FO	5/4/2010	326.26	278.35	173,540
25	OO	6/8/2010	258.88	256.93	142,609
26	FO	6/15/2010	470.30	461.58	150,640
27	FO	6/29/2010	322.24	534.05	120,316
28	FO	7/13/2010	177.49	174.67	22,634
29	OO	8/10/2010	413.13	394.25	59,396

<sup>a</sup>Data obtained from PCS exposure records and human studies database EES performance summary report;

<sup>b</sup>Measured at the inlet to the chamber. FO: fish oil supplementation; OO: olive oil supplementation; n/a: no filter data for this run.

**Supplemental Material, Table 3.** Individual variables before and after exposure.

Variables	Fish oil (n=16)						Olive oil (n=13)					
	Filtered Air		CAP			Filtered Air		CAP				
	Pre	Post	Pre	Post	FU	Pre	Post	Pre	Post	FU		
nHF	48.2±1.9	47.8±1.9	45.5±2.1	45.7±2.1	43.7±2.7	49.4±1.6	50.9±2.0	46.0±1.5	45.4±1.5	46.0±1.9		
nLF	30.7±1.8	33.1±1.7	31.4±1.7	33.0±1.8	31.8±1.7	35.0±1.6	33.1±1.4	34.6±1.9	36.5±1.6	36.3±1.2		
HF/LF	1.66±0.13	1.51±0.10	1.52±0.10	1.47±0.11	1.45±0.12	1.46±0.11	1.58±0.10	1.39±0.10	1.28±0.08	1.30±0.09		
QTc (ms)	425.3±4.3	424.5±4.6	423.7±3.8	424.8±3.7	423.9±3.2	416.2±3.5	416.7±3.6	413.4±3.8	416.1±3.7	416.6±3.9		
QTp (ms)	318.2±5.0	325.1±5.4	312.4±4.9	320.4±5.7	309.9±5.9	321.5±3.1	321.8±3.7	311.2±3.1	315.2±4.1	314.8±5.7		
Tp-Te (ms)	96.0±2.1	94.0±2.4	93.6±1.9	93.7±2.4	95.8±2.9	97.7±2.2	98.8±2.5	96.0±2.2	96.1±1.8	97.8±2.5		
Tp-Te/QT	0.232±0.004	0.224±0.005	0.230±0.004	0.227±0.005	0.236±0.007	0.233±0.004	0.235±0.005	0.236±0.005	0.233±0.005	0.238±0.006		
HR <sub>mean</sub> (bpm)	64.0±2.0	61.1±2.1	66.2±2.4	63.7±2.3	67.6±2.7	58.7±1.6	57.8±1.6	62.1±1.4	60.8±1.7	60.7±1.8		
T-cholesterol (mg/dl)	196±12	204±12	192±11	199±11	186±10	205±7	205±8	201±8	208±8	195±7		
LDL (mg/dl)	113±10	120±9	110±9	114±9	108±9	114±7	112±7	113±7	113±7	106±6		
VLDL (mg/dl)	29±5	30±5	29±4	30±4	28±4	44±7	45±7	42±7	44±6	43±7		
HDL (mg/dl)	59±4	61±4	57±4	58±4	54±4	65±5	65±5	64±5	64±5	61±5		
Triglyceride (mg/dl)	121±17	118±15	127±15	129±15	120±13	131±11	141±15	123±11	154±18	142±19		
WBC (x10 <sup>3</sup> /µl)	5.5±0.3	6.3±0.3	5.2±0.2	6.0±0.1	5.4±0.2	5.2±0.3	6.2±0.3	5.6±0.5	6.4±0.3	5.4±0.3		
Neutrophils (%)	53±2	55±2	53±2	54±2	54±2	56±3	58±3	60±3	58±3	57±3		
Lymphocytes (%)	37±2	36±2	37±2	37±2	36±2	33±2	31±2	30±3	31±3	33±3		
Monocytes (%)	7.1±0.5	7.5±0.6	6.9±0.5	7.1±0.4	7.3±0.5	7.2±0.4	7.4±0.5	6.6±0.4	7.3±0.5	6.8±0.5		
RBC (x10 <sup>6</sup> /µl)	4.5±0.1	4.5±0.1	4.4±0.1	4.4±0.1	4.3±0.1	4.5±0.1	4.6±0.1	4.5±0.1	4.6±0.1	4.4±0.1		
Platelets (x10 <sup>3</sup> /µl)	253±14	260±14	250±14	260±15	248±14	232±12	243±13	233±11	243±12	231±12		

Values are means ± SE. Pre: pre-exposure; Post: post-exposure; FU: follow up; nHF: normalized high frequency; nLF: normalized low frequency; HF/LF: high frequency/low frequency ratio; QTc: heart rate corrected QT interval; QTp: peak of QT interval ; Tp-Te: the interval from the peak of the T-wave to the end of the T-wave; Tp-Te/QT: ratio of Tp-Te over the total duration of QT; HR<sub>mean</sub>: mean heart rate; T-cholesterol : total cholesterol; VLDL: very low- density lipoprotein; LDL: low density lipoprotein; HDL: high density lipoprotein; WBC: white blood cells; RBC: red blood cells.

**Supplemental Material, Table 4.** Plasma lipids levels before and after supplementations.

Lipids	Fish oil (n=16)			Olive oil (n=13)		
	Before	After	p value	Before	After	p value
Total cholesterol (mg/dl)	201±12	196±12	0.27	214 ± 7	205±7	0.08
LDL (mg/dl)	117 ± 10	113±10	0.35	125 ± 9	114±7	0.04
VLDL (mg/dl)	19 ± 2	29±5	0.02	19 ± 3	44±7	0.01
HDL (mg/dl)	64 ± 4	59±4	0.02	70 ± 6	65±5	0.04
Triglyceride (mg/dl)	97 ± 10	121±17	0.05	94 ± 14	131±11	0.001

Values are means  $\pm$  SE. Before: before supplementation; After: after 4 weeks of supplementation; LDL: low density lipoprotein; VLDL: very low-density lipoprotein; HDL: high density lipoprotein; Student's t-test was used to compare the difference between the before and after supplementation levels.